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ENVIRONMENTAL MONITORING REPORT

UNITED STATES ATOMIC ENERGY COMMISSION

OAK RIDGE FACILITIES

Calendar Year 1971

APPROVAL FOR RELEASE

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UNION CARBIDE CORPORATION

NUCLEAR DIVISION

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UNION CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT • OAK RIDGE NATIONAL LABORATORY

OAK RIDGE Y-12 PLANT • PADUCAH GASEOUS DIFFUSION PLANT

For the Atomic Energy Commission Under U.S. Government Contract W7405 eng 26

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ENVIRONMENTAL MONITORING REPORT
UNITED STATES ATOMIC ENERGY COMMISSION
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Calendar Year 1971

UNION CARBIDE CORPORATION • NUCLEAR DIVISION

Oak Ridge Gaseous Diffusion Plant
Oak Ridge National Laboratory
Oak Ridge Y-12 Plant

Office of Safety and Environmental Protection
Post Office Box Y
Oak Ridge, Tennessee 37830

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INTRODUCTION

The Oak Ridge area incorporates three separate operating facilities, the Oak Ridge National Laboratory (ORNL), the Oak Ridge Gaseous Diffusion Plant (ORGDP), and the Y-12 Plant, all of which are operated by Union Carbide Corporation, Nuclear Division. In addition, two smaller AEC facilities are in the area—the UT-AEC Agricultural Research Station and Oak Ridge Associated Universities.

Oak Ridge National Laboratory is a large multi-purpose research laboratory whose basic mission is the discovery of new knowledge, both basic and applied, in all areas related to nuclear energy. To accomplish this mission, the Laboratory conducts research in all fields of modern science and technology. Oak Ridge National Laboratory employs a multi-disciplinary staff of approximately 4500 employees composed largely of engineers and scientists in the traditional science fields, supplemented by numerous social scientists and support personnel. The Laboratory's facilities consist of nuclear reactors, chemical pilot plants, research laboratories, radioisotope production laboratories, and support facilities.

The Oak Ridge Gaseous Diffusion Plant is a complex of production, research, development, and supporting facilities, distributed over a 640-acre area of eastern Tennessee and employs approximately 2700 personnel. The primary mission of the plant is the enrichment of uranium hexafluoride in the uranium-235 isotope, with the performance of other atomic energy related activities as required by the Atomic Energy Commission. To accomplish these assignments a physical plant has been constructed at an initial capital cost of about $815,000,000. The principal process facilities are the five gaseous diffusion cascade buildings, portions of which are now in standby. These are supplemented by about 70 support buildings and facilities (maintenance, supply stores, administration, cafeteria, data processing, etc). Union Carbide Corporation, Nuclear Division has been responsible for operating the Oak Ridge Gaseous Diffusion Plant since its inception.

The Oak Ridge Y-12 Plant occupies approximately 500 acres and is located immediately adjacent to the city of Oak Ridge, Tennessee. It is about 2-1/2 miles long and 1/4 mile wide. Today, Y-12 employs about 6500 people, including some 700 scientists and engineers and over 2000 craftsmen. The Y-12 Plant has four major responsibilities: (1) production of atomic weapon components, (2) fabrication support for weapon design agencies, (3) support for the Oak Ridge National Laboratory, and (4) support and assistance to other government agencies. Activities associated with these functions include the production of lithium compounds, the recovery of enriched uranium from unirradiated scrap material and the fabrication of uranium and other materials into finished parts and assemblies.

Fabrication operations include vacuum casting, arc melting, powder compaction, rolling, forming, heat treating, machining, inspection, and testing. As an indication of the scope of Y-12's work, the plant has over 1500 machine tools located in over 50 environmentally controlled shops.

SUMMARY

This report presents the results of the environmental monitoring program for the Oak Ridge area for calendar year 1971. The monitoring program includes sampling and analysis of air, water from surface streams, several food products, flora, and soil for both radioactive and non-radioactive materials.

Surveillance of radioactivity in the Oak Ridge environs indicated that the atmospheric concentrations of radioactivity were not significantly different from other areas in East Tennessee. Concentrations of radioactivity in the Clinch River and in fish collected from the river were less than 1 % of the permissible concentration and intake guides for individuals in neighboring populations. Only very low-level radioactivity is being released to the environment from plant operations and the resulting concentrations in all of the media sampled were well below permissible standards.

Surveillance of non-radioactive materials in the Oak Ridge environs shows that established limits were not exceeded for those materials possibly present in the air as a result of plant operations. The data obtained from the water sampling programs indicate compliance to established standards with the exception of chromium in the discharge of White Oak Dam and chromium and pH at the outlet of New Hope Pond on East Fork Poplar Creek. Several possibilities for reducing the level of chromium at White Oak Dam are being investigated. Similar investigations are being conducted to control both chromium and pH within acceptable levels at New Hope Pond. Although cyanide data on samples from the outlet of New Hope Pond and Bear Creek show concentrations above the U. S. Public Health Service Drinking Water Standard, the sensitivity of the analytical method used was inadequate for the required detection limit. These streams are not direct sources of public drinking water; nevertheless, efforts are being made to improve the cyanide analytical technique. Concentrations of fluorides in pine needles and grasses would not be expected to produce adverse effects in the most sensitive species.

MONITORING DATA COLLECTION, ANALYSIS, AND EVALUATION

Air Monitoring

Radioactive - Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations (HP-31 through HP-39) which encircle the perimeter of the Oak Ridge area and provides data for evaluating releases from Oak Ridge facilities to the immediate environment, Figure 1. A second system consists of eight stations (HP-51 through HP-58) encircling the Oak Ridge area at distances of from 12 to 75 miles, Figure 2. This system provides background data to aid in evaluating local conditions. Sampling for radioactive particulates is carried

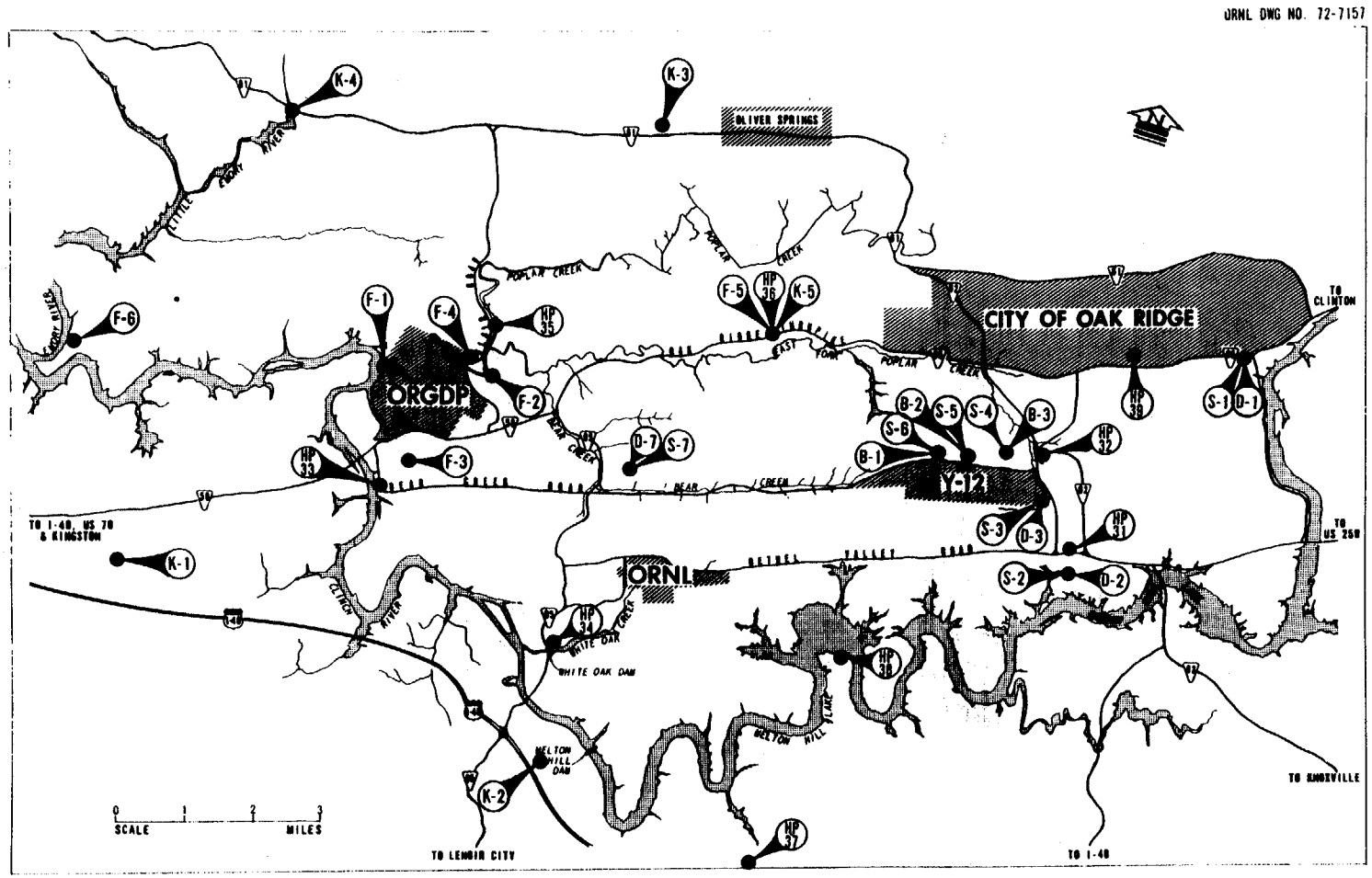

Figure 1

LOCATIONS OF AIR MONITORING STATIONS

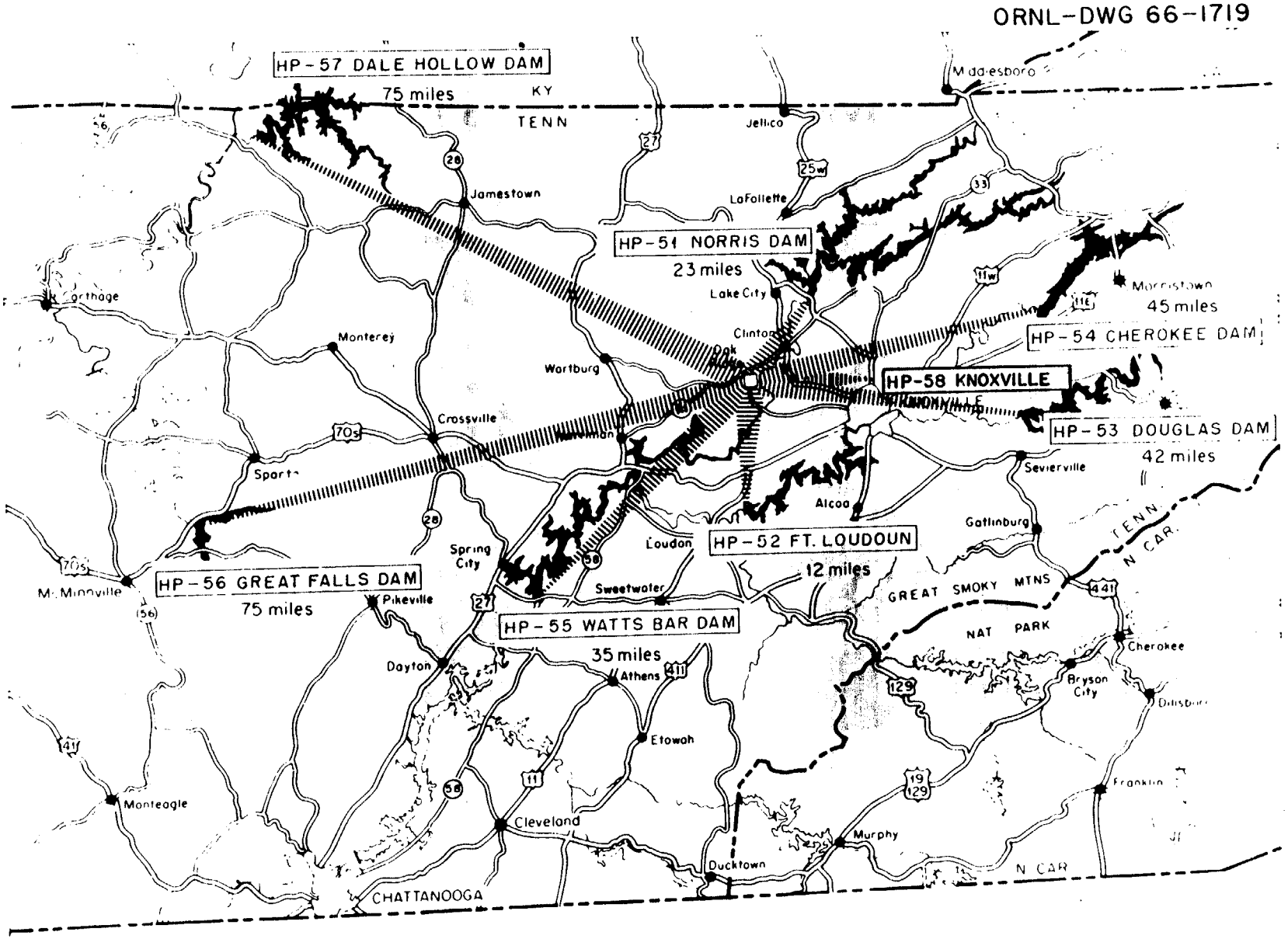

Figure 2

STATION SITES FOR REMOTE AIR MONITORING SYSTEM

out by passing air continuously through filter papers. Filter papers are evaluated by gross beta and gross alpha counting techniques for normal operations. More detailed analyses are performed when concentrations in the environment are significantly above normal. Airborne radioactive iodine is monitored by passing air continuously through cartridges containing activated charcoal. Charcoal cartridges are evaluated for radioactive iodine by gamma spectrometry.

Data on the concentrations of radioactive materials in air in the Oak Ridge and surrounding areas are given in Tables 1 through 3. The average gross beta concentrations of radioactivity from particulates in air measured by the perimeter and remote monitoring systems were less than 0.23% and 0.23%, respectively, of the applicable concentration guide (CG) specified in the AEC Manual, Appendix 0524, [1] for individuals in uncontrolled areas (Table 1). The average gross alpha concentrations were less than 0.05% of the concentration guide for natural uranium in both systems (Table 2). The average concentration of ^{131}I measured by the perimeter air monitoring system was less than 0.01% of the inhalation concentration guide for individuals in uncontrolled areas (Table 3).

The uniform level of filterable activity measured by the perimeter and remote stations indicated that the activity was of non-plant origin. While some ^{131}I was released to the atmosphere during the year, measurements in the Oak Ridge area showed that environmental concentrations were well below established standards.

Non-Radioactive - Environmental air samples are taken for the determinations of fluorides, reactive sulfur and dustfall.

Sampling locations for fluorides are indicated by F-1 through F-6, Figure 1. Concentrations in the ppb range are determined in a 24-hour period using a colorimetric method utilizing erochrome cyanine R as the color reagent.

Air sampling locations for the determination of reactive sulfur are indicated by S-1 through S-7, Figure 1. The lead peroxide candle technique is used for the collection of reactive sulfur (oxides). Each sampling station consists of a stand, a louvered shelter, and a prepared lead peroxide candle. Candles are exposed to the atmosphere for a period of one month. Sulfur oxides react with the lead peroxide to form lead sulfate. The analytical procedure is a gravimetric method and results are calculated as mg SO_3/100 cm^2/day.

Dustfall concentrations are determined at points D-1, D-2, D-3, and D-7, Figure 1. The sampling stations consist of a stand, a glass collector, and a stainless steel collection container. Samples are collected for a period of one month and analyzed by the standard gravimetric method of analysis for dustfall. Results are calculated as gm/m^2/30-day period.

The results of the air monitoring data for fluroides are shown in Table 4. These data indicate that at no time did the average concentration exceed the air quality standard of 1.5 ppb set forth in the Tennessee Air Pollution Control Regulations. [2]

The results of air monitoring data for reactive sulfur are shown in Table 5. These data indicate that at no time was the average greater than the concentration established for land area classification "A" as defined in the Tennessee Air Pollution Control Regulations.

The results of air monitoring data for dustfall are shown in Table 6. These data also indicate that at no time was the average concentration greater than the lower limit of 9 gm/m^2/30-day period established for land area classification "A" as defined in the Tennessee Air Pollution Control Regulations.

Water Monitoring

Liquid wastes originating at the three major Oak Ridge facilities are discharged, after treatment, to White Oak Creek, Poplar Creek, East Fork Poplar Creek, and Bear Creek which are small tributaries to the Clinch River.

Radioactive - A continuous proportional sample is collected at White Oak Dam (Station W-1), which is the last on-site control point prior to the entry of White Oak Creek into the Clinch River, and composited for monthly analysis. Continuous proportional samples are collected in the Clinch River at Melton Hill Dam (Station C-2) 2.3 miles above White Oak Creek outfall and at the ORGDP water intake (Station C-3) 6.3 miles downstream of the entry of White Oak Creek. A grab sample is collected daily from the Clinch River at Center's Ferry near Kingston, Tennessee (Station C-5), Figure 3. Clinch River samples are composited for quarterly analysis.

The concentrations of radionuclides present in detectably significant amounts are determined by specific radionuclide analysis and gamma spectrometry. The concentration of each radionuclide is compared with its respective concentration guide (CG) value as specified in the AEC Manual, Appendix 0524, and the resulting fractions are summed to obtain the percent CG in the Clinch River.

Water samples are collected in Poplar Creek upstream of the ORGDP (Station P-1), in Poplar Creek downstream from the ORGDP waste discharges (Station P-2), and in the Clinch River downstream from the Poplar Creek outfall (Station C-4), Figure 3. Semi-annual grab samples are collected in Poplar Creek to verify the continued compliance demonstrated by continuous samples taken over a 12-year period. A continuous sample is collected in the Clinch River and composited over a three-month period for analysis. Samples are analyzed for uranium by the fluorometric method.

Continuous proportional water samples are collected at the outlet of New Hope Pond on East Fork Poplar Creek (Station E-1). Weekly grab samples were collected on Bear Creek (Station B-1) during the first nine months of 1971, Figure 3, while the last three month's samples were obtained by a continuous proportional sampler. Samples are analyzed on a monthly basis by gross alpha counting techniques.

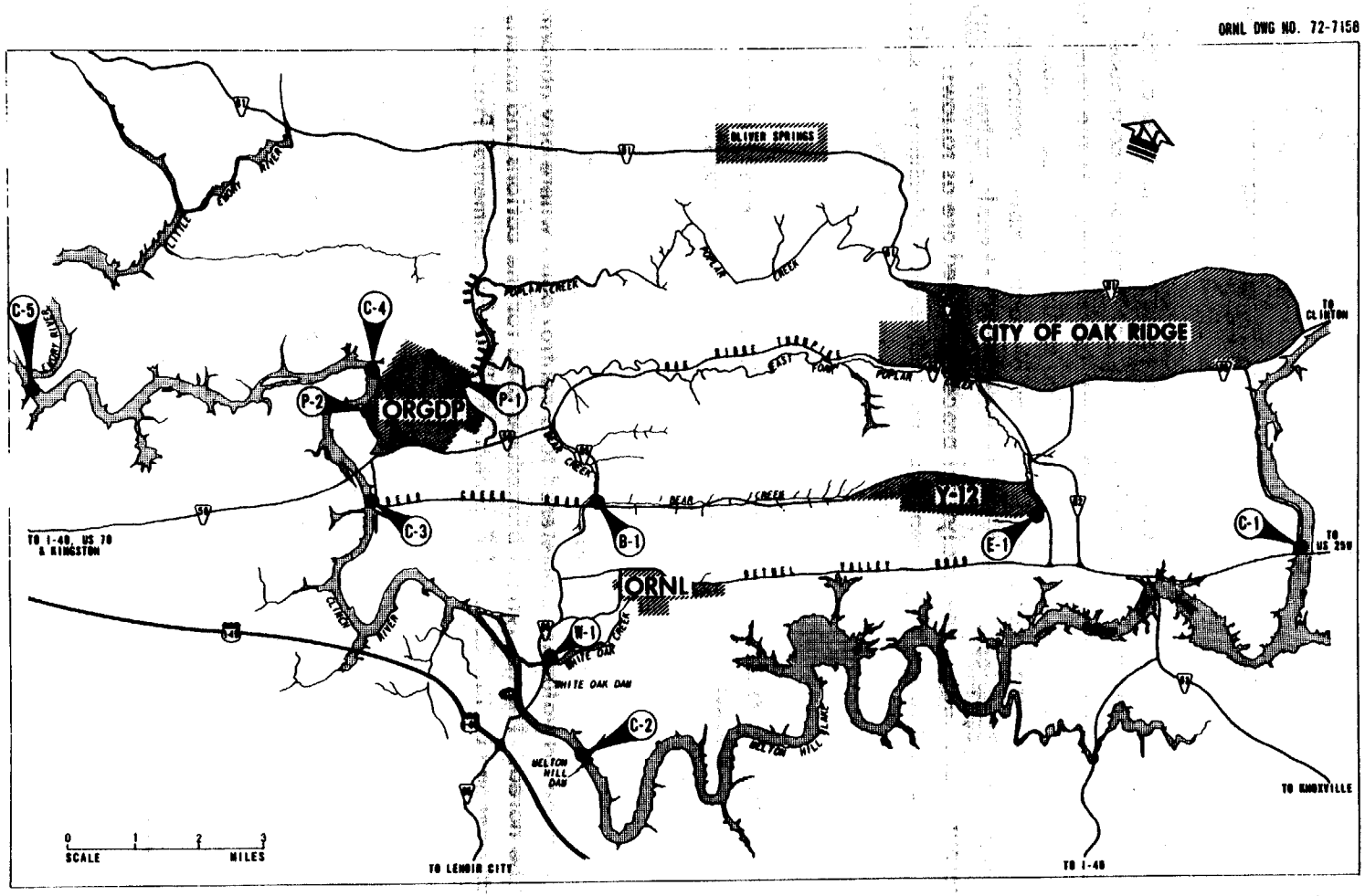

Figure 3

LOCATIONS OF STREAM MONITORING STATIONS

The average concentrations of specific radionuclides in the Clinch River at all points of measurement were less than 1 % of the applicable concentration guides for uncontrolled areas (Table 7). The average concentration of transuranic alpha emitters in the Clinch River at CRM 20.8 was 0.5×10^{-11} μCi/ml, which is less than 0.01% of the concentration guide for water in uncontrolled areas containing an unknown mixture of radionuclides.* Average concentrations of uranium in the surface streams on the Oak Ridge area were no greater than 1.2% of the applicable concentration guide for uncontrolled areas (Table 8).

Non-Radioactive - Water samples are collected on a routine basis at locations W-1, C-1, and C-3 (Figure 3). Location W-1 is monitored by a continuous sampling device which collects a sample proportional to the flow. At the other two locations (C-1 and C-3), samples are taken on a grab sample basis. Both proportional and grab samples are collected weekly and a portion of each sample is composited for quarterly analysis. Samples are analyzed for chromium, phenols, sulfates, nitrates, chlorides, mercury, and lead. The analytical procedures used are as follows: chromium by spectrographic method, phenols by chromatographic technique, sulfates by turbidimetric method, nitrates and chlorides by specific ion electrodes, and mercury and lead by isotopic dilution technique.

Samples are also collected at locations P-1, P-2, and C-4 (Figure 3) for the determination of nitrates, fluorides, and chromium. Samples are analyzed for total chromium by atomic absorption, for nitrates by wet chemistry, and for fluorides by specific ion electrodes.

Sampling for a variety of cations and anions is also performed at locations E-1 and B-1 (Figure 3). The pH and flow of East Fork Poplar Creek (E-1) are recorded continuously and the pH value is telemetered to a central point where any abnormal changes may be noted. The analytical procedures used for the cations and anions are those recommended by the Corps of Engineers and the Environmental Protection Agency.

Water monitoring data for sample locations W-1, C-1, and C-3 are shown in Tables 9, 10, and 11. With the exception of chromium at location W-1, the concentrations of all substances analyzed are below the applicable standards.[3] Investigations are underway to reduce the chromium levels at location W-1.

Water monitoring data for locations P-1, P-2, and C-4 (Figure 3) are shown in Table 12. Concentrations determined on all three parameters are less than the applicable standard.

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*CG is 1×10^{-7} μCi/ml - AEC Manual, Appendix 0524.[1]

Water monitoring data for location E-1 are shown in Table 13. Chromium concentrations at this point (E-1) are 4.6 times the U. S. Public Health Service Drinking Water Standard. This is a direct result of the corrosion inhibitor used in cooling tower water. Investigations are underway to reduce the chromium content in the cooling tower discharge water.

The cyanide concentration for location E-1 (Table 13) is above the U. S. Public Health Service Drinking Water Standard. This stream is not a direct source of public drinking water. Further the analytical techniques available for cyanides are not adequate to provide reliable data at the level of the drinking water standard. Whether the cyanide limit is actually being exceeded cannot be determined until samples are analyzed by a new technique with a lower limit of detection. Compliance is expected since the only source of cyanides in East Fork Poplar Creek is very dilute rinse water from a limited number of plating operations. It should also be pointed out that all values reported as less than the minimum detection limits were in fact assigned that value for the purpose of determining an average concentration and percent of standard. This results in an average higher than the absolute average. Consequently, these values for percent standard are indicated as less than (<) values.

The pH in the effluent from New Hope Pond on East Fork Poplar Creek (E-1) slightly exceeded the State limits for fish and aquatic life streams. The lower limit of 6.5 was exceeded on 33 days during CY 1971, but each time it was only for a few hours or minutes, and only by a few tenths of a pH unit. The maximum change in pH in 24 hours exceeded the State limit of 1 unit by only a few tenths of a unit on ten days. The pH variations described above would not produce any significant impact on the receiving stream. Part of the pH control problem results from cooling tower blowdown water. With the present corrosion control system, the cooling towers operate at a pH close to the lower State standard for fish and aquatic life streams.[4] Investigations are underway to improve pH control.

Reliable measurements of the dissolved oxygen content in the effluent from the New Hope Pond into East Fork Poplar Creek (E-1) were started in October, 1971. Measurements of 10.8 mg/l maximum, 5.7 mg/l minimum, and 7.6 mg/l average were obtained with a direct reading meter. All measurements were in compliance with the State limit of 5.0 mg/l minimum for fish and aquatic life streams. It is possible that the minimum dissolved oxygen content could drop below 5.0 mg/l during the hot summer days with the current condition of the pond. The decomposition of algae in the pond is imposing an abnormal BOD loading. This condition will be alleviated in CY 1972 by dredging the decaying algae and sediment from the pond.

The water monitoring data for location B-1 are shown in Table 14. These data indicate that with the exception of cyanides, all concentrations are less than the applicable standards. As previously indicated, the method of averaging and calculating percent standard tends to bias the results high. The comments above on the reliability of the analytical technique for East Fork Poplar Creek (E-1) also apply to Bear Creek (B-1).

Food Sources

Milk Monitoring - Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from 12 sampling stations located within a radius of 50 miles of Oak Ridge. Samples are collected weekly at each of eight stations located near the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. Milk sampling locations for the eight stations near the Oak Ridge area are shown in Figure 4. Samples are analyzed by ion exchange techniques and results are compared to intake guides specified by the Federal Radiation Council (FRC).[5]

The average concentrations of ^{131}I and ^{90}Sr in raw milk are given in Tables 15 and 16. If one assumes the average intake of milk per individual to be 1 liter per day, the average concentration of ^{131}I in the milk in the immediate environs of the Oak Ridge area was just above the lower limit of FRC Range II. The average concentration in the environs remote from Oak Ridge was within FRC Range I. The average concentrations of ^{90}Sr in milk from both the immediate and remote environs were within the FRC Range I. The average concentrations measured in the Oak Ridge area do not differ significantly from the values in the southeastern United States reported by the Environmental Protection Agency's Pasturized Milk Sampling Network.

Fish Sampling - Two species of fish from the Clinch River are sampled during the spring and summer of each year. The fish are prepared for radiochemical analysis in a manner analogous to human utilization. Ten fish of each species are composited for each sample and the samples are analyzed by gamma spectrometry and radiochemical techniques for the critical radionuclides contributing significantly to the potential radiation dose to man. An estimate of man's intake of radionuclides from eating Clinch River fish is made by assuming an annual rate of fish consumption of 14 lbs.,[a] and the estimated percentage of maximum permissible intake is calculated by assuming a maximum permissible intake of radionuclides from eating fish to be comparable to a daily intake of 2.2 liters[7] of water containing the concentration guide of the radionuclides in question for a period of one year.

Data on the concentrations of radionuclides in Clinch River fish are given in Table 17. The levels measured were less than 1 % of that required to obtain an estimated maximum permissible intake.

Flora and Soil

Radioactive - Soil samples are collected annually from near the Perimeter Air Monitoring Stations, Figure 1. Four samples, approximately three inches in diameter and one centimeter thick, are collected in a one-square-meter area at each location, composited, and analyzed radiochemically for uranium and plutonium content to determine historical background information.

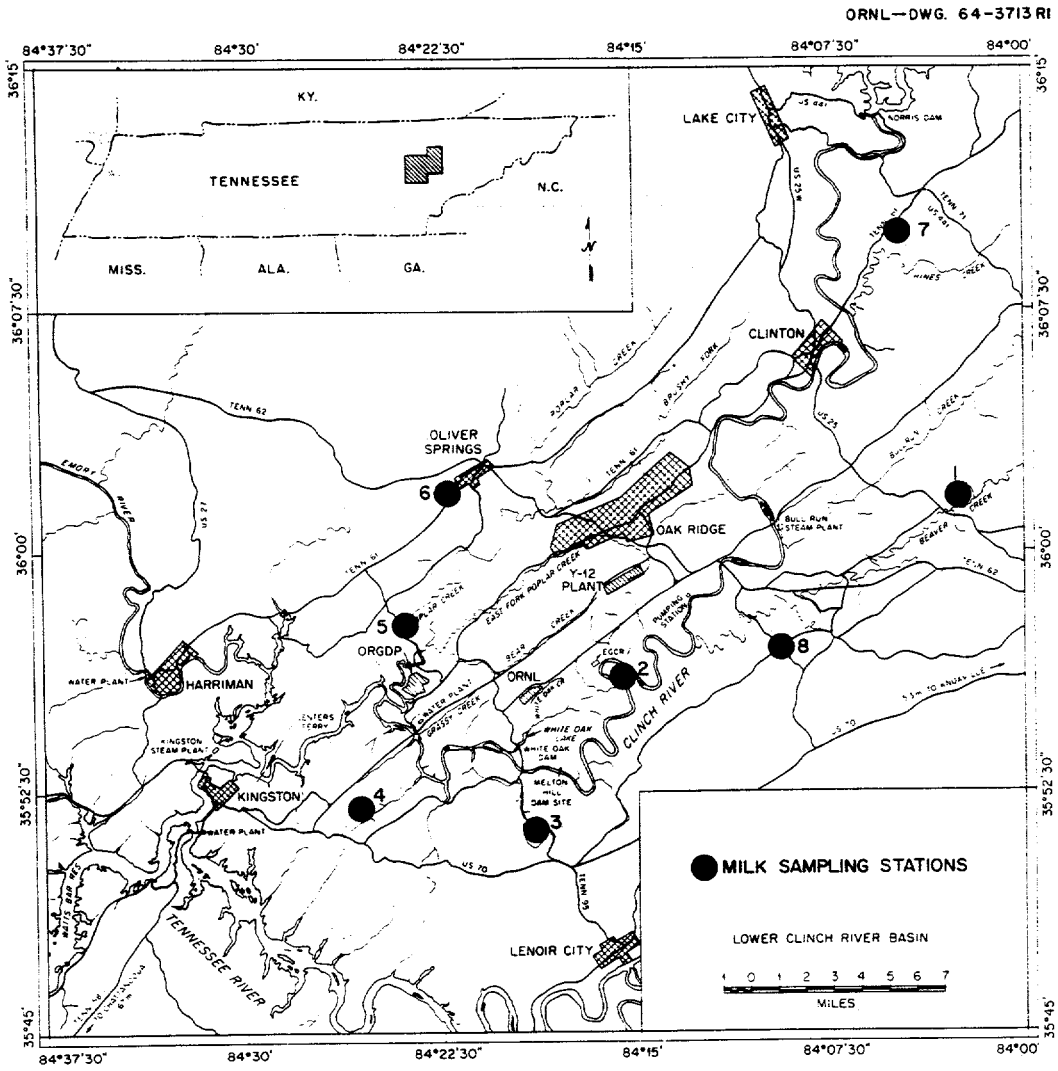

Figure 4

LOCATIONS OF MILK SAMPLING STATIONS

Soil, pine needle, and grass samples are collected semi-annually from five sampling locations (K-1 through K-5) located on a five-mile radius from the ORGDP Plant, Figure 1. Samples are analyzed for uranium by the fluorometric method.

Data on uranium concentrations in soil and flora are given in Tables 18 and 19.

Non-Radioactive - Samples of pine needles and grasses are collected at locations K-1 through K-5 (Figure 1). The data are shown in Table 20. Since the concentrations detected in both pine needles and grass are all less than 30 ppm, no adverse effects would be anticipated. This is substantiated by the article which appeared in the open literature[8] which stated that dairy cattle, the species of livestock most sensitive to fluorides in grasses, would suffer no adverse effects.

Table 1

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

1971

Station Number	Location	Number of Samples Taken	Units of 10^{-13} µCi/ml			% CG[c]
			Maximum[a]	Minimum[b]	Average	
		Perimeter Stations[d]				
HP-31	Kerr Hollow Gate	52	6.4	0.35	2.2	0.22
HP-32	Midway Gate	52	7.2	< 0.03	< 2.3	< 0.23
HP-33	Gallaher Gate	52	8.2	< 0.03	< 2.0	< 0.20
HP-34	White Oak Dam	52	7.0	< 0.03	< 2.2	< 0.22
HP-35	Blair Gate	52	8.4	0.23	2.3	0.23
HP-36	Turnpike Gate	249[e]	8.0	0.10	2.6	0.26
HP-37	Hickory Creek Bend	52	6.9	< 0.03	< 1.9	< 0.19
HP-38	East of EGCR	52	6.6	< 0.03	< 2.3	< 0.23
HP-39	Townsite	52	8.8	0.13	2.5	0.25
Average			7.5	< 0.11	< 2.3	< 0.23
		Remote Stations[f]				
HP-51	Norris Dam	51	7.2	0.28	2.2	0.22
HP-52	Loudoun Dam	51	7.6	0.28	2.3	0.23
HP-53	Douglas Dam	52	6.5	0.03	2.2	0.22
HP-54	Cherokee Dam	51	7.5	0.33	2.3	0.23
HP-55	Watts Bar Dam	52	8.2	0.29	2.5	0.25
HP-56	Great Falls Dam	52	6.7	0.24	2.4	0.24
HP-57	Dale Hollow Dam	52	6.8	0.34	2.2	0.22
HP-58	Knoxville	48	6.7	0.04	2.2	0.22
Average			7.2	0.23	2.3	0.23

[a] Maximum weekly average concentration.

[b] Minimum weekly average concentration - minimum detectable level is 5×10^{-6} µCi per sample.

[c] CG is 10^{-10} µCi/ml for unidentified radionuclides (AEC Manual, Appendix 0524, Annex A, Table II).

[d] See Figure 1.

[e] Samples collected five days per week.

[f] See Figure 2.

Table 2

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity
of Particulates in Air

1971

Station Number	Location	Number of Samples Taken	Units of 10^{-13} µCi/ml			% CG[c]
			Maximum[a]	Minimum[b]	Average	
		Perimeter Stations[d]				
HP-31	Kerr Hollow Gate	52	0.05	< 0.01	< 0.01	< 0.05
HP-32	Midway Gate	52	0.05	< 0.01	< 0.02	< 0.10
HP-33	Gallaher Gate	52	0.07	< 0.01	< 0.01	< 0.05
HP-34	White Oak Dam	52	0.04	< 0.01	< 0.01	< 0.05
HP-35	Blair Gate	52	0.05	< 0.01	< 0.01	< 0.05
HP-36	Turnpike Gate	249[e]	0.14	< 0.01	< 0.04	< 0.20
HP-37	Hickory Creek Bend	52	0.02	< 0.01	< 0.01	< 0.05
HP-38	East of EGCR	52	0.05	< 0.01	< 0.02	< 0.10
HP-39	Townsite	52	0.03	< 0.01	< 0.01	< 0.05
Average			0.06	< 0.01	< 0.01	< 0.05
		Remote Stations[f]				
HP-51	Norris Dam	51	0.03	< 0.01	< 0.01	< 0.05
HP-52	Loudoun Dam	51	0.04	< 0.01	< 0.01	< 0.05
HP-53	Douglas Dam	52	0.05	< 0.01	< 0.01	< 0.05
HP-54	Cherokee Dam	51	0.04	< 0.01	< 0.01	< 0.05
HP-55	Watts Bar Dam	52	0.05	< 0.01	< 0.01	< 0.05
HP-56	Great Falls Dam	52	0.03	< 0.01	< 0.01	< 0.05
HP-57	Dale Hollow Dam	52	0.03	< 0.01	< 0.01	< 0.05
HP-58	Knoxville	48	0.05	< 0.01	< 0.01	< 0.05
Average			0.04	< 0.01	< 0.01	< 0.05

[a] Maximum weekly average concentration.

[b] Minimum weekly average concentration - minimum detectable level is 2×10^{-6} µCi per sample.

[c] CG is 20×10^{-13} µCi/ml for natural uranium (AEC Manual, Appendix 0524, Annex A, Table II).

[d] See Figure 1.

[e] Samples collected five days per week.

[f] See Figure 2.

Table 3

CONCENTRATION OF ^{131}I IN AIR
AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS[a]

1971

Number of Samples	Units of 10^{-14} µCi/ml			% CG[c]
	Maximum	Minimum[b]	Average	
468	6.1	< 0.6	< 1.1	< 0.01

[a] See Figure 1.

[b] Minimum detectable amount of ^{131}I is 10×10^{-6} µCi per sample.

[c] CG is 1×10^{-10} µCi/ml (AEC Manual, Appendix 0524, Annex A, Table II).

Table 4

AIR MONITORING DATA - FLUORIDES

1971

Location[a]	Number of Samples[b]	Concentration, ppb			% STD.[e]
		Maximum[c]	Minimum[d]	Average	
F-1	45	2.5	0.2	0.9	60
F-2	45	2.2	< 0.2	< 0.8	< 53
F-3	45	1.8	< 0.2	< 0.8	< 53
F-4	44	1.9	< 0.2	< 1.0	< 67
F-5	45	1.5	< 0.2	< 0.7	< 47
F-6	43	1.1	< 0.2	< 0.5	< 33

[a]See Figure 1.

[b]Sample duration - 24 hours.

[c]Maximum - 24-hour concentration.

[d]Minimum - 24-hour concentration.

[e]Air Quality Standard (STD.) - 1.5 ppb by volume for 30 days - Tennessee Air Pollution Control Regulations.

Table 5

AIR MONITORING DATA - REACTIVE SULFUR

1971

Location[a]	Number of Samples	Concentration mg SO_3/100 cm^2/day			% STD.[b]
		Maximum	Minimum	Average	
S-1	12	0.25	0.01	0.10	13
S-2	12	0.29	0.03	0.12	15
S-3	12	0.59	0.09	0.25	32
S-4	12	0.79	0.08	0.32	39
S-5	12	0.84	0.11	0.35	44
S-6	12	0.39	0.12	0.24	30
S-7	12	0.21	0.02	0.09	11

[a]See Figure 1.

[b]Tennessee Air Pollution Control Regulations for Land Area Classification "A": 0.8 mg SO_3/100 cm^2/day.

Table 6

AIR MONITORING DATA - DUSTFALL

1971

Location[a]	Number of Samples	Concentration gm/m^2/30-day period			% STD.[b]
		Maximum	Minimum	Average	
D-1	10	2.96	0.03	0.90	10[c]
D-2	12	3.93	0.19	1.50	17[c]
D-3	12	1.89	0.14	0.84	9[c]
D-7	12	2.11	0.11	0.91	10[c]

[a]See Figure 1.

[b]Tennessee Air Pollution Control Regulations for Land Area Classification "A": 9 - 18 gm/m^2/30-day period. The lower limit of nine should not be exceeded more than 50% of the time during any 12-month period. The upper limit of 18 is not to be exceeded during any 30-day period.

[c]Calculated by using the average value and lower limit of nine.

Table 7

RADIONUCLIDES IN THE CLINCH RIVER

1971

Sampling Location	No. Samples	Range	Concentration of Radionuclides of Primary Concern Units of 10^{-8} µCi/ml							% CG[c]
			^{90}Sr	^{144}Ce	^{137}Cs	$^{106-103}Ru$	^{60}Co	$^{95}Zr-^{95}Nb$	^{3}H	
C2 CRM 23.1[a]	4	Max.	0.07	0.05	0.03	0.18	0.04	0.02	< 100	
		Min.	0.03	0.01	< 0.01	0.07	0.01	< 0.01	< 100	
		Avg.	0.05	0.03	< 0.01	0.12	0.03	< 0.01	< 100	< 0.21
W1 CRM 20.8[b]	12	Max.	0.18	< 0.01	0.06	0.03	0.05	< 0.01	516	
		Min.	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	51	
		Avg.	0.05	< 0.01	0.01	< 0.01	< 0.01	< 0.01	115	< 0.20
C3 CRM 14.5[a]	4	Max.	0.27	0.07	0.20	0.48	0.09	0.05	658	
		Min.	0.14	< 0.01	0.06	0.10	0.03	< 0.01	< 100	
		Avg.	0.18	< 0.03	0.13	0.27	0.06	< 0.02	< 297	< 0.75
C5 CRM 4.5[a]	4	Max.	0.14	0.05	0.13	0.33	0.19	0.03	518	
		Min.	0.05	0.01	0.05	0.05	0.02	< 0.01	< 100	
		Avg.	0.10	0.03	0.09	0.20	0.08	< 0.01	< 221	< 0.45

[a] Measured values.

[b] Values given for this location are calculated values based on the concentrations measured at White Oak Dam and the dilution afforded by the Clinch River. They do not include radioactive materials (e.g., fallout) that may enter the river upstream of White Oak Creek outfall (CRM 20.8).

[c] Applicable concentration guides and the method for calculating percent of concentration guide for a known mixture of radionuclides are given in AEC Manual, Appendix 0524, Annex A.(1)

Table 8

URANIUM CONCENTRATION IN SURFACE STREAMS

1971

Station Number[a]	Location	Number of Samples	Units of 10^{-8} µCi/ml			% CG[b]
			Maximum	Minimum	Average	
P-1	Poplar Creek	2	4.0	1.0	2.5	0.1
P-2	Poplar Creek	2	13.0	1.3	7.1	0.3
C-4	Clinch River	4	0.6	0.0	0.3	< 0.1
E-1	East Fork Poplar Creek	12	40	16	24	1.2
B-1	Bear Creek	12	70	10	23	1.2

[a] See Figure 3.

[b] CG is 2×10^{-5} µCi/ml (AEC Manual, Appendix 0524, Annex A, Table II).

Table 9

NON-RADIOACTIVE WATER MONITORING DATA—WHITE OAK DAM

(Location W-1, Figure 3)

1971

Substance	Number of Samples	Concentration, mg/l				% STD.
		Maximum	Minimum	Average	STD.	
Cr	3	1.000	0.100	0.400	0.05[a]	800
Phenols	4	0.0008	0.0001	0.0005	0.001[a]	50
$SO_4^{=}$	4	39.0	28.5	34.4	250[a]	14
NO_3^-	4	8.7	0.9	5.3	45[a]	12
Cl^-	4	6.5	3.1	4.8	250[a]	2
Hg	32	0.0070	< 0.0005	< 0.0020	0.005[b]	< 40
Pb	3	0.02	< 0.005	< 0.012	0.05[a]	< 24

[a]U.S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standard.[9]

Table 10

NON-RADIOACTIVE WATER MONITORING DATA—MELTON HILL LAKE

(Location C-1, Figure 3)

1971

Substance	Number of Samples	Concentration, mg/l				% STD.
		Maximum	Minimum	Average	STD.	
Cr	3	< 0.005	< 0.005	< 0.005	0.05[a]	< 10
Phenols	3	0.0006	0.0001	0.0004	0.0010[a]	40
$SO_4^{=}$	4	27	21.5	24	250[a]	10
NO_3^-	4	9.1	0.8	6.0	45[a]	13
Cl^-	4	5.00	1.00	2.8	250[a]	1
Hg	33	0.0080	< 0.0005	< 0.0022	0.005[b]	< 44
Pb	3	0.03	0.01	0.02	0.05[a]	40

[a]U.S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standard.[9]

Table 11

NON-RADIOACTIVE WATER MONITORING DATA--ORGDP PUMPING STATION

(Location C-3, Figure 3)

1971

Substance	Number of Samples	Concentration, mg/l				% STD.
		Maximum	Minimum	Average	STD.	
Cr	11	0.008	0.005	0.005	0.05[a]	10
Phenols	3	0.0004	0.0001	0.0002	0.001[a]	20
$SO_4^=$	4	25.2	21.0	22.7	250[a]	9
NO_3^-	4	7.5	0.7	4.7	45[a]	10
Cl^-	4	5.5	1.6	3.1	250[a]	1
Hg	32	0.0070	< 0.0005	< 0.0018	0.005[b]	< 36
Pb	3	0.02	< 0.005	< 0.012	0.05[a]	< 24

[a]U.S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standard.[9]

Table 12

NON-RADIOACTIVE WATER MONITORING DATA—POPLAR CREEK AND CLINCH RIVER

1971

Substance	Location[a]	Number of Samples	Concentration, mg/l				% STD.
			Maximum	Minimum	Average	STD.[b]	
NO_3^-	P-1	2	2.0	1.0	1.5	45	3
	P-2	2	3.0	1.5	2.2	45	5
	C-4	2	2.4	2.0	2.2	45	5
F^-	P-1	2	0.3	0.2	0.25	1.2	21
	P-2	2	0.3	0.2	0.25	1.2	21
	C-4	2	0.3	0.2	0.25	1.2	21
Cr	P-1	2	< 0.004	< 0.004	< 0.004	0.05	< 8
	P-2	2	< 0.004	< 0.004	< 0.004	0.05	< 8
	C-4	2	< 0.004	< 0.004	< 0.004	0.05	< 8

[a]Figure 3.

[b]U.S. Public Health Service Drinking Water Standards.

Table 13

NON-RADIOACTIVE WATER MONITORING DATA—
EAST FORK POPLAR CREEK

(Location E-1, Figure 3)

1971

Substance	Number of Samples	Concentration, mg/l				% STD.
		Maximum	Minimum	Average	STD.	
Cd	12	< 0.01	< 0.01	< 0.01	0.01[a]	< 100
Cl^-	12	18.0	2.1	10.6	250[a]	4
Cr	7	0.55	0.1	0.23	0.05[a]	460
CN	12	< 0.03	< 0.03	< 0.03	0.01[a]	< 300
DO	49	10.8	5.7	7.6	5.0[c]	Complies
F^-	12	1.84	0.76	1.11	1.2[a]	93
Fe	12	0.60	< 0.1	< 0.23	0.3[a]	< 77
Hg	9	0.0070	0.0005	0.003	0.005[b]	60
Mn	12	0.06	< 0.005	< 0.016	0.05[a]	< 32
NO_3^-	12	16.29	< 0.04	< 7.82	45.0[a]	< 17
Pb	12	0.03	< 0.005	< 0.01	0.05[a]	< 20
$SO_4^=$	12	60.9	34.8	47.7	250[a]	19
T.D.S.	4	343	107	239	500[a]	48
Zn	10	0.07	0.007	0.03	5.0[a]	< 1

[a]U.S. Public Health Drinking Water Standards.

[b]Proposed EPA Standard.[9]

[c]Tennessee Water Quality Standard.

Table 14

NON-RADIOACTIVE WATER MONITORING DATA—BEAR CREEK

(Location B-1, Figure 3)

1971

Substance	Number of Samples	Concentration, mg/l				% STD.
		Maximum	Minimum	Average	STD.[a]	
Cd	11	< 0.01	< 0.01	< 0.01	0.01	< 100
Cl^-	10	26.9	5.3	10.4	250	4
Cr	12	0.02	< 0.004	< 0.01	0.05	< 20
CN	10	0.04	< 0.01	< 0.03	0.01	< 300
F^-	10	0.79	0.2	0.49	1.2	41
NO_3^-	12	54.3	5.0	41.0	45	91
$SO_4^=$	10	30.0	15.2	23.2	250	9
Zn	9	0.034	0.003	0.012	5.0	< 1

[a]U.S. Public Health Drinking Water Standards.

Table 15

CONCENTRATION OF ^{131}I IN RAW MILK

1971

Location	No. Samples	Units of 10^{-9} μCi/ml			Comparison with Standard[b]
		Maximum	Minimum[a]	Average	
Immediate Environs[c]	389	21	< 10	< 10.1	FRC Range II
Remote Environs	38	< 10	< 10	< 10	FRC Range I

[a]Minimum detectable concentration of ^{131}I is 10×10^{-9} μCi/ml.

[b]Applicable FRC standard, assuming 1 liter per day intake:

Range I 0 to 1×10^{-8} μCi/ml - Adequate surveillance required to confirm calculated intakes.

Range II 1×10^{-8} μCi/ml to 1×10^{-7} μCi/ml - Active surveillance required.

Range III 1×10^{-7} μCi/ml to 1×10^{-6} μCi/ml - Positive control action required.

Note: Upper limit of Range II can be considered the concentration guide.

[c]See Figure 4.

Table 16

CONCENTRATION OF ^{90}SR IN RAW MILK

1971

Location	No. Samples	Units of 10^{-9} µCi/ml			Comparison with Standard[b]
		Maximum	Minimum[a]	Average	
Immediate Environs[c]	389	32	2.4	11.4	FRC Range I
Remote Environs	38	15	6.8	9.4	FRC Range I

[a]Minimum detectable concentration of ^{90}Sr in milk is 2×10^{-9} µCi/ml.

[b]Applicable FRC Standard, assuming 1 liter per day intake:

Range I	0 to 2×10^{-8} µCi/ml	- Adequate surveillance required to confirm calculated intakes.
Range II	2×10^{-8} µCi/ml to 2×10^{-7} µCi/ml	- Active surveillance required.
Range III	2×10^{-7} µCi/ml to 2×10^{-6} µCi/ml	- Positive control action required.

Note: Upper limit of Range II can be considered the concentration guide.

[c]See Figure 4.

Table 17

RADIONUCLIDE CONTENT OF CLINCH RIVER FISH

1971

Species	No. Samples[a]	pCi/kg Wet Weight			Estimated % MPI[b]
		^{90}Sr	^{106}Ru	^{137}Cs	
White Crappie	1	135	< 180	343	< 0.38
Smallmouth Buffalo	1	108	< 315	336	< 0.32

[a] Composite of ten fish in each species.

[b] Maximum Permissible Intake - Assumes intake of radionuclides from eating fish to be comparable to a daily intake of 2.2 liters of water for the year containing the concentration guide level of the radionuclides in question.

Table 18

SOIL SAMPLES FROM NEAR
PERIMETER AIR MONITORING STATIONS

1971

Sampling[a] Location	Number Samples[b]	Dry Soil[c] Units of 10^{-8} µCi/g	
		Plutonium (α)	Uranium
HP-31	1	3.3	11
HP-32	1	2.8	7
HP-33	1	2.4	23
HP-34	1	3.8	23
HP-35	1	4.7	32
HP-36	1	2.4	29
HP-37	1	1.4	14
HP-38	1	2.8	14
HP-39	1	5.2	63

[a] See Figure 1.

[b] Four samples, approximately three inches in diameter and one centimeter thick, collected in a one-square-meter area at each location and composited for analysis.

[c] Applicable concentration guides for soil contamination have not been established.

Table 19

URANIUM IN SOIL, PINE NEEDLES, AND GRASSES
AT FIVE-MILE RADIUS FROM ORGDP

1971

Substance	Location[a]	Number of Samples	Units of 10^{-8} µCi/gram		
			Maximum	Minimum	Average
Soil[b]	K-1	2	70	15.0	42.5
	K-2	2	65	35.0	50.0
	K-3	2	40	35.0	37.5
	K-4	2	45	40.0	42.5
	K-5	2	65	40.0	52.5
Pine Needles[c]	K-1	2	10	5.0	7.5
	K-2	2	10	3.5	6.7
	K-3	2	20	3.5	11.7
	K-4	2	20	3.5	11.7
	K-5	2	25	3.5	14.2
Grass[c]	K-1	2	35	5.0	20.0
	K-2	2	25	10.0	17.5
	K-3	2	15	3.5	9.2
	K-4	2	20	5.0	12.5
	K-5	2	30	3.5	16.7

[a]See Figure 1.

[b]Top two inches of soil on a dry basis.

[c]Dry basis.

NOTE: Applicable guides for flora and soil have not been established.

Table 20

FLORA MONITORING DATA—FLUORIDES

1971

Substance	Location[a]	Number of Samples	Units of ppm[b]		
			Maximum	Minimum	Average
Pine Needles	K-1	2	15	14	14.5
	K-2	2	17	10	13.5
	K-3	2	15	5	10.0
	K-4	2	13	9	16.0
	K-5	2	28	7	17.5
Grasses	K-1	2	26	25	25.5
	K-2	2	32	21	26.5
	K-3	2	26	10	18.0
	K-4	2	20	12	16.0
	K-5	2	13	11	12.0

[a]See Figure 1.

[b]Analytical results are on a dry weight basis.

NOTE: Applicable guides for flora have not been established. However, for comparison, the American Industrial Hygiene Association Journal for January-February 1969 (pp. 98-101) states that dairy cattle is the species of livestock most sensitive to fluorides in grasses. For comparative purposes the following fluoride concentrations and their effect on dairy cattle are given:

30 ppm	- no adverse effects
30 to 40 ppm	- borderline chronic
40 to 60 ppm	- moderate chronic
60 to 110 ppm	- severe chronic
above 250 ppm	- acute

REFERENCES

1. AEC Manual, Appendix 0524, Annex A.

2. Tennessee Air Pollution Control Regulations, adopted by the Tennessee Air Pollution Control Board, effective August 9, 1969.

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6. Agricultural Statistics 1969, U.S. Department of Agriculture, U.S. Government Printing Office, Washington, 1969.

7. Recommendations of the International Commission on Radiological Protection, ICRP Publication 2, Report of Committee II on Permissible Dose for Internal Radiation, 1959.

8. Journal of the American Industrial Hygiene Association, January-February, 1969 (pp. 98-101).

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